

Claims

- [c1] Apparatus for sterilizing and detoxifying the inside of an enclosure comprising means for generating a concentration of hydroxyl free radicals inside said enclosure of at least about 10^{12} molecules/cc for at least 1 minute.
- [c2] Apparatus according to Claim 1 wherein said means for generating hydroxyl free radicals is an ozonizer, a hydrogen atom donor, an ultraviolet lamp, and means for mixing said ozone and said hydrogen donor and exposing said mixture to light from said ultraviolet lamp.
- [c3] Apparatus according to Claim 2 wherein said ozonizer is outside said enclosure and said hydroxyl free radicals are generated inside said enclosure.
- [c4] Apparatus according to Claim 2 wherein said hydrogen atom donor is water vapor.
- [c5] Apparatus according to Claim 1 wherein said means for generating hydroxyl free radicals is hydrogen gas, nitrogen dioxide gas, an ultraviolet lamp, and a means for mixing and releasing them inside said enclosure.
- [c6] Apparatus according to Claim 1 including means for maintaining the inside of said enclosure at a temperature of about 0 to about 70 ° C.
- [c7] Apparatus according to Claim 1 including means for maintaining the relative humidity inside said enclosure at about 10 to about 40%.
- [c8] Apparatus according to Claim 1 including a pump for pumping gas out of said enclosure whereby the inside said enclosure is at less than atmospheric pressure.
- [c9] Apparatus according to Claim 1 wherein said enclosure contains *Bacillus anthracis*.
- [c10] A method of detoxifying the inside of an enclosure using an apparatus according to Claim 1 comprising generating said hydroxyl free radicals and releasing them inside said enclosure at a concentration of at least about 10^{16} molecules/cc for at least 1 minute.

- [c11] A method according to Claim 10 wherein said hydroxyl free radicals are generated by reacting ozone with water in the presence of ultraviolet light.
- [c12] A method according to Claim 10 wherein said hydroxyl free radicals are generated by reacting hydrogen with nitrogen dioxide in the presence of ultraviolet light.
- [c13] Apparatus for detoxifying the inside of a room containing pathogens comprising
- (A) an ultraviolet lamp for generating ultraviolet light at a wavelength of less than about 300 nm;
 - (B) an ozonizer outside of said room, for generating ozone from air;
 - (C) a source of a gaseous hydrogen atom donor; and
 - (D) means for mixing said ozone with said gaseous hydrogen atom donor, exposing said mixture to said ultraviolet radiation inside said enclosure, said apparatus being capable of generating a concentration of hydroxyl free radicals inside said enclosure of at least about 10^{16} molecules/cc for at least about 1 hour.
- [c14] Apparatus according to Claim 13 wherein said hydrogen atom donor is water vapor.
- [c15] Apparatus according to Claim 13 wherein said UV light can generate at least about $1 \mu\text{-Joule/cm}^2$ of ultraviolet light per mole of said ozone at a wavelength of about 100 to about 300 nm.
- [c16] A method of detoxifying the inside an enclosure using an apparatus according to Claim 13 comprising
- (A) generating ozone with said ozonizer;
 - (B) turning on said ultraviolet lamp;
 - (C) mixing said ozone and said water vapor at a molar ratio of about 1:1 to about 10:1; and
 - (D) exposing said mixture to said ultraviolet light inside said enclosure, whereby hydroxyl free radicals are formed at a concentration of at least about 10^{16} molecules/cc for at least about 1 hour.

- [c17] A method according to Claim 16 wherein said hydrogen atom donor is water vapor.
- [c18] A method according to Claim 16 wherein the relative humidity inside said enclosure is about 10 to about 40% and the temperature inside said enclosure is about 0 to about 70 ° C.
- [c19] Apparatus for sterilizing the inside of a room containing pathogens comprising
- (A) an ozonizer outside of said room, for generating ozone;
 - (B) an ultraviolet lamp for generating about $1 \mu\text{-Joule/cm}^2$ to about 1 Joule/cm^2 of ultraviolet light per mole of said ozone at a wavelength of about 100 to about 300 nm;
 - (C) a source of water vapor; and
 - (D) means for mixing said ozone with said water vapor in a molar ratio of ozone to water of about 1:1 to about 10:1 and exposing said mixture to said ultraviolet light inside said room, said apparatus being capable of generating a concentration of hydroxyl free radicals inside said room is at least about 10^{16} molecules/cc for at least about 1 hour.
- [c20] A method of sterilizing the inside a room using an apparatus according to Claim 19 comprising
- (A) generating ozone with said ozonizer;
 - (B) turning on said ultraviolet lamp;
 - (C) mixing said ozone and said water vapor at a molar ratio of ozone to water vapor of about 1:1 to about 10:1; and
 - (D) exposing said mixture to said ultraviolet light, whereby hydroxyl free radicals are formed inside said room at a concentration of at least about 10^{16} molecules/cc for at least about 1 hour.